EXHIBIT L

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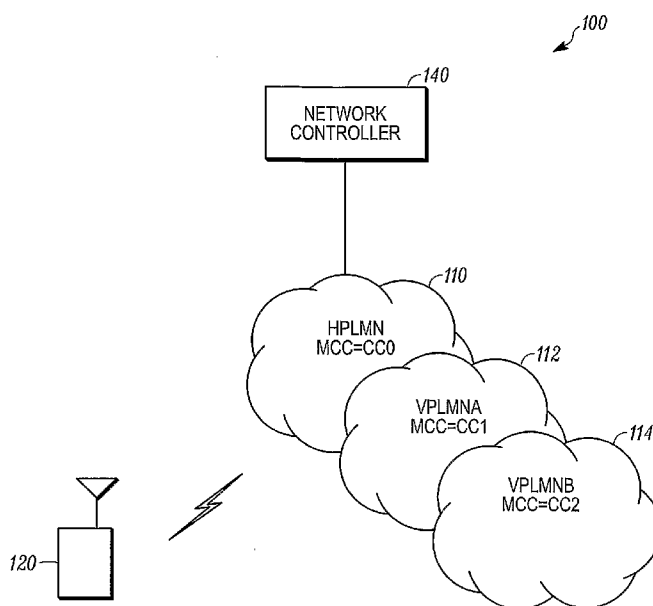
(57) **Abstract:** A method in a mobile communication device having a home public land mobile network, the home public land mobile network having a first country code. An alternate country code for the home public land mobile network is stored. The mobile communication device operates on a visiting public land mobile network having a second country code. A public land mobile network search is performed. The mobile communication device switches to the home public land mobile network based on the public land mobile network search.

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ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.*

APPARATUS AND METHOD FOR HOME NETWORK SEARCH

BACKGROUND

Technical Field

5   The present disclosure is directed to a method and apparatus for a home network search. More particularly, the present disclosure is directed to performing a home public land mobile network search while in a visiting public land mobile network that is using a different mobile country code from the home public land mobile network.

10   ### Background Art

Presently, a mobile communication device cannot to move to its home public land mobile network (HPLMN) during a periodic public land mobile network (PLMN) search when the mobile is registered on a visiting public land mobile network (VPLMN) using a different mobile country code (MCC) from its HPLMN.

15   For example, the mobile communication device is effectively outside of its home country. This limitation creates problems when the mobile communication device is in a country which shares multiple country codes. For example Hong Kong became part of China and some of the existing operators continue to use different country codes. Also, many countries have multiple MCC's allocated for use by different

20   operators and therefore, the use of a single MCC to identify a country is not always possible. For example most countries in Europe have two MCC's allocated to the geographical region.

Unfortunately, a user of a mobile communication device, under such conditions, potentially ends up paying more due to being registered, or "roaming," on

25   a VPLMN even though the user may be in the vicinity of the HPLMN. An operator of an HPLMN can also potentially loose out on revenue because its subscribers will be roaming all of the time after loosing coverage of the HPLMN as long as the VPLMN coverage exists.

For example, a mobile communication device can lose coverage of the

30   HPLMN and moves to a different VPLMN with a different country code in the same country. After a while the mobile communication device may come back to coverage

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of an overlap area of the HPLMN and the VPLMN. Unfortunately, because the VPLMN has a different country code from the HPLMN, the mobile communication device is forbidden from camping and registering on its HPLMN, even if it was originally registered on its HPLMN in the current vicinity.

5   Thus, there is a need for performing a HPLMN search while in a VPLMN network that is using a different mobile country code from the HPLMN but is in a concurrent region with the HPLMN.

SUMMARY

10   A method in a mobile communication device having a home public land mobile network, the home public land mobile network having a first country code. An alternate country code for the home public land mobile network is stored. The mobile communication device operates on a visiting public land mobile network having a second country code. A public land mobile network search is performed.
15   The mobile communication device switches to the home public land mobile network based on the public land mobile network search.

BRIEF DESCRIPTION OF THE DRAWINGS

           The embodiments of the present disclosure will be described with reference to
20   the following figures, wherein like numerals designate like elements, and wherein:
           Fig. 1 is an exemplary block diagram of a system according to one embodiment;
           Fig. 2 is an exemplary block diagram of a mobile communication device according to one embodiment;
25   Fig. 3 is an exemplary flowchart illustrating the operation of a mobile communication device according to one embodiment; and
           Fig. 4 is an exemplary flowchart illustrating the operation of a mobile communication device according to another embodiment.

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DISCLOSURE OF THE INVENTION

Fig. 1 is an exemplary block diagram of a system 100 according to one embodiment. The system 100 can include a network controller 140, a home network 110, visiting networks 112 and 114, and a terminal 120. The terminal 120 may be a

5   mobile communication device, such as wireless telephone, a cellular telephone, a personal digital assistant, a pager, a personal computer, a selective call receiver or any other device that is capable of sending and receiving communication signals on a network including wireless network.

10   In an exemplary embodiment, the network controller 140 can be connected to the home network 110. The network controller 140 may be located at a base station, at a radio network controller, or anywhere else on the network 110. The network controller 140 may also or alternately be connected to the visiting networks 112 and 114. The networks 110, 112, and 114 may include any type of network that is capable

15   of sending and receiving signals, such as wireless signals. For example, the network 110 may include a wireless telecommunications network, a cellular telephone network, a satellite communications network, and other like communications systems. Furthermore, the network 110 may include more than one network and may include a plurality of different types of networks. Thus, the networks 110, 112, and 114 may

20   include a plurality of data networks, a plurality of telecommunications networks, a combination of data and telecommunications networks and other like communication systems capable of sending and receiving communication signals. The home network 110 can be a home public land mobile network (HPLMN) with a mobile country code (MCC) of CC0. The visiting network 112 can be a visiting public land mobile

25   network (VPLMN) with a MCC of CC1. The visiting network 114 can be a VPLMN with a MCC of CC2. The HPLMN 110 can have at least one first country code of a plurality of country codes, the at least one first country code being the home country code. Also, the VPLMN 112 can have at least one second country code of a plurality of country codes, the at least one second country code being a visiting country code.

30   For example, the VPLMN 112 can be a PLMN, different from the HPLMN 110,

where the MCC part of the PLMN identity is the same as MCC of the international mobile subscriber identity or the MCC part of the PLMN identity and MCC of the HPLMN are alternate country codes.

In operation, the HPLMN 110 can be the home network of the terminal 120. The terminal 120 can store an alternate country code for the HPLMN 110 as a second country code. The alternate country code can be different from any MCC's assigned to the HPLMN. The alternate country code for the HPLMN 110 can be stored in a public land mobile network list on a subscriber identity module (SIM) in the terminal 120. The terminal 120 can operate on the HPLMN. The terminal 120 may lose coverage of the HPLMN 110 and detect coverage of the VPLMN 112. The terminal 120 can then operate on the VPLMN 112 having the second country code. While operating on the VPLMN 112, the terminal 120 can perform a public land mobile network search and switch to the HPLMN 110 based on the public land mobile network search. The terminal can also receive an over the air refresh message for modifying stored country codes and modify country codes stored in the terminal 120 based on the over the air refresh message.

Thus, for example, an entry in a SIM card can be used by the terminal 120 when making decisions on whether or not to perform a switch to the HPLMN 110. This entry can be pre-programmed by a network operator at the time of subscription or can be dynamically changed using the "Over The Air" programming.

An exemplary entry can look like the following where:

- $M = 8$: Maximum number of alternate country codes for one home country,

- $K <= M$: Actual number of alternate country codes for one home country,

- HCC is the home country code, and

- If $K > M$, then K+1th to M entries can be invalid:

HCC
K (<= M) (Actual number of alternate country codes).   5
HCC1
HCC2
...
HCCK

10

From the table for the HPLMN, which bears the country code as HCC, the country codes HCC1 through HCCK can be treated as "alternate country codes" and the terminal 120 can be allowed to switch back to the HPLMN if it is on a PLMN bearing the country code belonging to any of HCC1 through HCCK. Similarly, the terminal 120 can be allowed to switch to a higher preferred PLMN bearing the country code belonging to any of HCC1 through HCCK, if it is currently on a PLMN bearing the country codes belonging to any of HCC1 through HCCK.

To accommodate the case of a user card where the terminal 120 can have multiple HPLMN codes, this structure can be expanded where:

- N : Maximum number of HPLMN identities,
- M(=8) : Maximum number of alternate country codes, and
- iK : the identity for the ith HPLMN ID, where ik <=M,

Ith entry   HCC - i
iK(<=M) (No. of valid alternate country codes)
HCC – i1
HCC – i2
...
HCC - iK
(If (ik < M), then ik+1th to M entries can be invalid).
Jth entry HCC - j
jK : No. of valid alternate country codes
HCC – j1
HCC – j2
...

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HCC - jK
...
...
Nth entry HCC - N
NK– No. of valid alternate country codes
HCC – N1
HCC – N2
...
HCC - NK
...

Thus, the terminal 120 can come back to the HPLMN 110 from the VPLMN 112. For example, the terminal 120 may coverage and camp on a VPLMN with a different country code as Home country code. The terminal 120 may come back to an overlap coverage area of the HPLMN 110 and the VPLMN 112. The terminal 120 can then come back to the HPLMN 110 from the VPLMN 112.

Without this disclosure, the terminal 120 is not be able to come back to HPLMN as long as it is in overlap area of the VPLMN 112 and the HPLMN 110. The disclosure allows for a SIM element 'Alternate home country codes' file that indicates a visited country code and a home country code are equivalent. The terminal 120 can then come back to the home network.

Fig. 2 is an exemplary block diagram of a mobile communication device 200, such as the terminal 120, according to one embodiment. The mobile communication device 200 can include a housing 210, a controller 220 coupled to the housing 210, audio input and output circuitry 230 coupled to the housing 210, a display 240 coupled to the housing 210, a transceiver 250 coupled to the housing 210, a user interface 260 coupled to the housing 210, a memory 270 coupled to the housing 210, and an antenna 280 coupled to the housing 210 and the transceiver 250. The mobile communication device 200 can also include a PLMN search module 290 and a PLMN switch module 292. The PLMN search module 290 and the PLMN switch module 292 can be coupled to the controller 220, can reside within the controller 220, can reside within the memory 270, can be autonomous modules, can be software, can be

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hardware, or can be in any other format useful for a module on a mobile
communication device 200.

   The display 240 can be a liquid crystal display (LCD), a light emitting diode
(LED) display, a plasma display, or any other means for displaying information.
According to one embodiment, the display 240 can, but does not need to indicate
when the mobile communication device is roaming on a VPLMN other than the
HPLMN. The transceiver 250 may include a transmitter and/or a receiver. The audio
input and output circuitry 230 can include a microphone, a speaker, a transducer, or
any other audio input and output circuitry. The user interface 260 can include a
keypad, buttons, a touch pad, a joystick, an additional display, or any other device
useful for providing an interface between a user and an electronic device. The
memory 270 may include a random access memory, a read only memory, an optical
memory, a subscriber identity module memory, or any other memory that can be
coupled to a mobile communication device. The memory 270 can include mobile
country code storage 272. The mobile country code storage 272 can include an
alternate country code 272 for the home public land mobile network 110. The mobile
country code storage 272 can be located on a subscriber identity module memory.
Furthermore the mobile country code storage can include multiple country codes for
the HPLMN 110 including at least one alternate country code for the HPLMN 110.
Thus, the HPLMN can have at least one MCC, such as a home MCC and the VPLMN
can have at least one MCC.

   The alternate country code can be the same code as a VPLMN country code.
For example, the alternate country code for the HPLMN 110 can be CC1. Thus, when
the mobile communication device 200 is operating on the VPLMN 112 with a
MCC=CC1, the mobile communication device 200 can know that it may be possible
to operate on the HPLMN 110 because the alternate country code for the HPLMN 110
is the same as the MCC for the VPLMN 112.

   In operation, the controller 220 can operate the mobile communication device
200 on a VPLMN 112 having a second country code CC1. The PLMN search module
290 can perform a public land mobile network search. The public land mobile

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network search can be a higher priority public land mobile network search that searches for a higher priority PLMN than the current PLMN. The PLMN switch module 292 can switch the mobile communication device 200 to the HPLMN 110 based on the public land mobile network search. The PLMN search module 290 can
5   detect the HPLMN 110 and the PLMN switch module 292 can switch to the HPLMN 110 based on the PLMN search module 290 detecting the HPLMN 110. The transceiver 250 can receive an over the air refresh message for modifying country codes stored in the memory 270 and the controller 220 can modify the stored country codes based on the over the air refresh message.

10   Fig. 3 is an exemplary flowchart 300 illustrating the operation of the mobile communication device 200 according to one embodiment. In step 310, the flowchart begins. In step 320, the mobile communication device 200 can store an alternate country code for the HPLMN 110. The mobile communication device 200 can store the alternate country code for the HPLMN 110 in a public land mobile network list on
15   a subscriber identity module. Also, the mobile communication device 200 can store multiple country codes for the HPLMN 110 and the multiple country codes can include the alternate country code for the HPLMN 110. The mobile communication device 200 can receive an over the air refresh message for modifying stored country codes and modify the stored country codes based on the over the air refresh message.

20   In step 330, the mobile communication device 200 can operate on the VPLMN 112 having a second country code. The alternate country code can be the same code as the second country code. In step 340 the mobile communication device 200 can perform a public land mobile network search. The public land mobile network search can be a higher priority public land mobile network search. In step 350, the mobile
25   communication device 200 can switch to the HPLMN 110 based on the public land mobile network search. The mobile communication device 200 can detect the HPLMN 110 while performing the public land mobile network search in step 340 and can then switch to the home public land mobile network in step 350 based on detecting the HPLMN 110. In step 360, the flowchart 300 ends.

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Fig. 4 is an exemplary flowchart 400 illustrating the operation of the mobile communication device 200 according to another embodiment. This flowchart 400 illustrates an example of the operation of a PLMN higher priority search in determining whether to switch to a detected PLMN while operating on a VPLMN 112.

5   In step 410, the flowchart begins. In step 420, the mobile communication device 200 can detect a PLMN other than the VPLMN 112 on which it is operating. In step 430, the mobile communication device 200 can determine if the MCC of the VPLMN 112 is in the range of 310-316. This step can be used because current standards assign the United States to a range of MCC's from 310-316 and have special

10   rules for these MCC's. However this step may not be necessary if the standards change. If the answer to step 430 is yes, in step 440, the mobile communication device 200 determines if the detected PLMN MCC is in the range of 310-316. If so, in step 450, the mobile communication device 200 moves to the detected PLMN. If not, in step 460, the mobile communication device 200 stays on the current VPLMN

15   112.

If the answer to step 430 is no, in step 470, the mobile communication device 200 can determine if the current VPLMN MCC is the same as the detected PLMN MCC. If so, in step 450, the mobile communication device 200 can move to the detected VPLMN. If not, in step 480, the mobile communication device 200 can

20   determine if the current VPLMN MCC is an alternate country code for the HPLMN 110. If not, in step 460, the mobile communication device 200 stays on the current VPLMN 112. If so, in step 490, the mobile communication device 200 can determine if the detected VPLMN MCC is an alternate country code for the HPLMN 110. If not, in step 460, the mobile communication device 200 stays on the current VPLMN 112.

25   If so, in step 495, the mobile communication device 200 can move to the detected VPLMN.

The method of this disclosure is preferably implemented on a programmed processor. However, the controllers, flowcharts, and modules may also be implemented on a general purpose or special purpose computer, a programmed

30   microprocessor or microcontroller and peripheral integrated circuit elements, an ASIC

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or other integrated circuit, a hardware electronic or logic circuit such as a discrete element circuit, a programmable logic device such as a PLD, PLA, FPGA or PAL, or the like. In general, any device on which resides a finite state machine capable of implementing the flowcharts shown in the Figures may be used to implement the

5   processor functions of this disclosure.

       While this disclosure has been described with specific embodiments thereof, it is evident that many alternatives, modifications, and variations will be apparent to those skilled in the art. For example, various components of the embodiments may be interchanged, added, or substituted in the other embodiments. Also, all of the

10   elements of each figure are not necessary for operation of the disclosed embodiments. For example, one of ordinary skill in the art of the disclosed embodiments would be enabled to make and use the teachings of the disclosure by simply employing the elements of the independent claims. Accordingly, the preferred embodiments of the disclosure as set forth herein are intended to be illustrative, not limiting. Various

15   changes may be made without departing from the spirit and scope of the disclosure.

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CLAIMS

1.   A method in a mobile communication device having a home public land mobile network, the home public land mobile network having a first country code, the method comprising:

5   storing an alternate country code for the home public land mobile network;

operating on a visiting public land mobile network having a second country code;

performing a public land mobile network search; and

switching to the home public land mobile network based on the public land

10   mobile network search.

2.   The method according to claim 1, wherein the alternate country code is the same code as the second country code.

15   3.   The method according to claim 1, wherein storing further comprises storing an alternate country code for the home public land mobile network in a public land mobile network list on a subscriber identity module.

4.   The method according to claim 1, further comprising detecting the home

20   public land mobile network,

wherein switching comprises switching to the home public land mobile network based on detecting the home public land mobile network.

5.   The method according to claim 1, wherein the public land mobile network

25   search is a higher priority public land mobile network search.

6.   The method according to claim 1, wherein storing an alternate country code for the home public land mobile network further comprises storing multiple country codes for the home public land mobile network, the multiple country codes including

30   the alternate country code for the home public land mobile network.

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7.   The method according to claim 1,

        wherein the home public land mobile network has at least one first country

code, the at least one first country code being a home country code, and

5   wherein the visiting public land mobile network has at least one second

country code, the at least one second country code being a visiting country code.

8.   The method according to claim 1, further comprising:

        receiving an over the air refresh message for modifying stored country codes;

10   and

        modifying stored country codes based on the over the air refresh message.

9.   A mobile communication device configured to operate on a home public land

mobile network, the home public land mobile network having a first country code, the

15   mobile communication device comprising:

        a transceiver;

        a memory including an alternate country code for the home public land mobile

network;

        a controller coupled to the transceiver and the memory, the controller

20   configured to operate the mobile communication device on a visiting public land

mobile network having a second country code;

        a public land mobile network search module configured to perform a public

land mobile network search; and

        a public land mobile network switch module configured to switch the mobile

25   communication device to the home public land mobile network based on the public

land mobile network search.

10.   The mobile communication device according to claim 9, wherein the alternate

country code is the same code as the second country code.

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11.   The mobile communication device according to claim 9, wherein the memory includes the alternate country code for the home public land mobile network in a public land mobile network list on a subscriber identity module.

5   12.   The mobile communication device according to claim 9, wherein the public land mobile network search module is further configured to detect the home public land mobile network, and

wherein the public land mobile network switch module is further configured to switch to the home public land mobile network based on detecting the home public

10   land mobile network.

13.   The mobile communication device according to claim 9, wherein the public land mobile network search is a higher priority public land mobile network search.

15   14.   The mobile communication device according to claim 9, wherein the memory includes multiple country codes for the home public land mobile network, the multiple country codes including the alternate country code for the home public land mobile network.

20   15.   The mobile communication device according to claim 9,

wherein the home public land mobile network has at least one first country code, the at least one first country code being a home country code, and

wherein the visiting public land mobile network has at least one second country code, the at least one second country code being a visiting country code.

25

16.   The mobile communication device according to claim 9, wherein the transceiver is configured to receive an over the air refresh message for modifying stored country codes, and

wherein the controller is further configured to modify stored country codes

30   based on the over the air refresh message.

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17.   A method in a mobile communication device having a home public land mobile network, the home public land mobile network having a first country code, the method comprising:

5   storing an alternate country code for the home public land mobile network as a second country code;

operating on a home public land mobile network having the second country code;

losing coverage of the home public land mobile network;

10   detecting coverage of a visiting public land mobile network;

operating on the visiting public land mobile network having the second country code;

performing a public land mobile network search; and

switching to the home public land mobile network based on the public land

15   mobile network search.

18.   The method according to claim 17, wherein storing further comprises storing an alternate country code for the home public land mobile network in a public land mobile network list on a subscriber identity module.

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19.   The method according to claim 17, further comprising:

receiving an over the air refresh message for modifying stored country codes; and

modifying stored country codes based on the over the air refresh message.

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AMENDED CLAIMS

received by the International Bureau on 17 November 2006 (17.11.2006)

1.   A method in a mobile communication device having a home public land mobile network, the home public land mobile network having a first country code, the method comprising:

storing an alternate country code for the home public land mobile network;

operating on a visiting public land mobile network having a second country code;

performing a public land mobile network search; and

switching to the home public land mobile network based on the public land mobile network search.

2.   The method according to claim 1, wherein the alternate country code is the same code as the second country code.

3.   The method according to claim 1, wherein storing further comprises storing an alternate country code for the home public land mobile network in a public land mobile network list on a subscriber identity module.

4.   The method according to claim 1, further comprising detecting the home public land mobile network,

wherein switching comprises switching to the home public land mobile network based on detecting the home public land mobile network.

5.   The method according to claim 1, wherein the public land mobile network search is a higher priority public land mobile network search.

6.   A mobile communication device configured to operate on a home public land mobile network, the home public land mobile network having a first country code, the mobile communication device comprising:

a transceiver;

AMENDED SHEET (ARTICLE 19)

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a memory including an alternate country code for the home public land mobile network;

a controller coupled to the transceiver and the memory, the controller configured to operate the mobile communication device on a visiting public land mobile network having a second country code;

a public land mobile network search module configured to perform a public land mobile network search; and

a public land mobile network switch module configured to switch the mobile communication device to the home public land mobile network based on the public land mobile network search.

7.   The mobile communication device according to claim 6, wherein the alternate country code is the same code as the second country code.

8.   The mobile communication device according to claim 6, wherein the memory includes the alternate country code for the home public land mobile network in a public land mobile network list on a subscriber identity module.

9.   The mobile communication device according to claim 6, wherein the public land mobile network search module is further configured to detect the home public land mobile network, and

wherein the public land mobile network switch module is further configured to switch to the home public land mobile network based on detecting the home public land mobile network.

10.   The mobile communication device according to claim 6, wherein the public land mobile network search is a higher priority public land mobile network search.

AMENDED SHEET (ARTICLE 19)
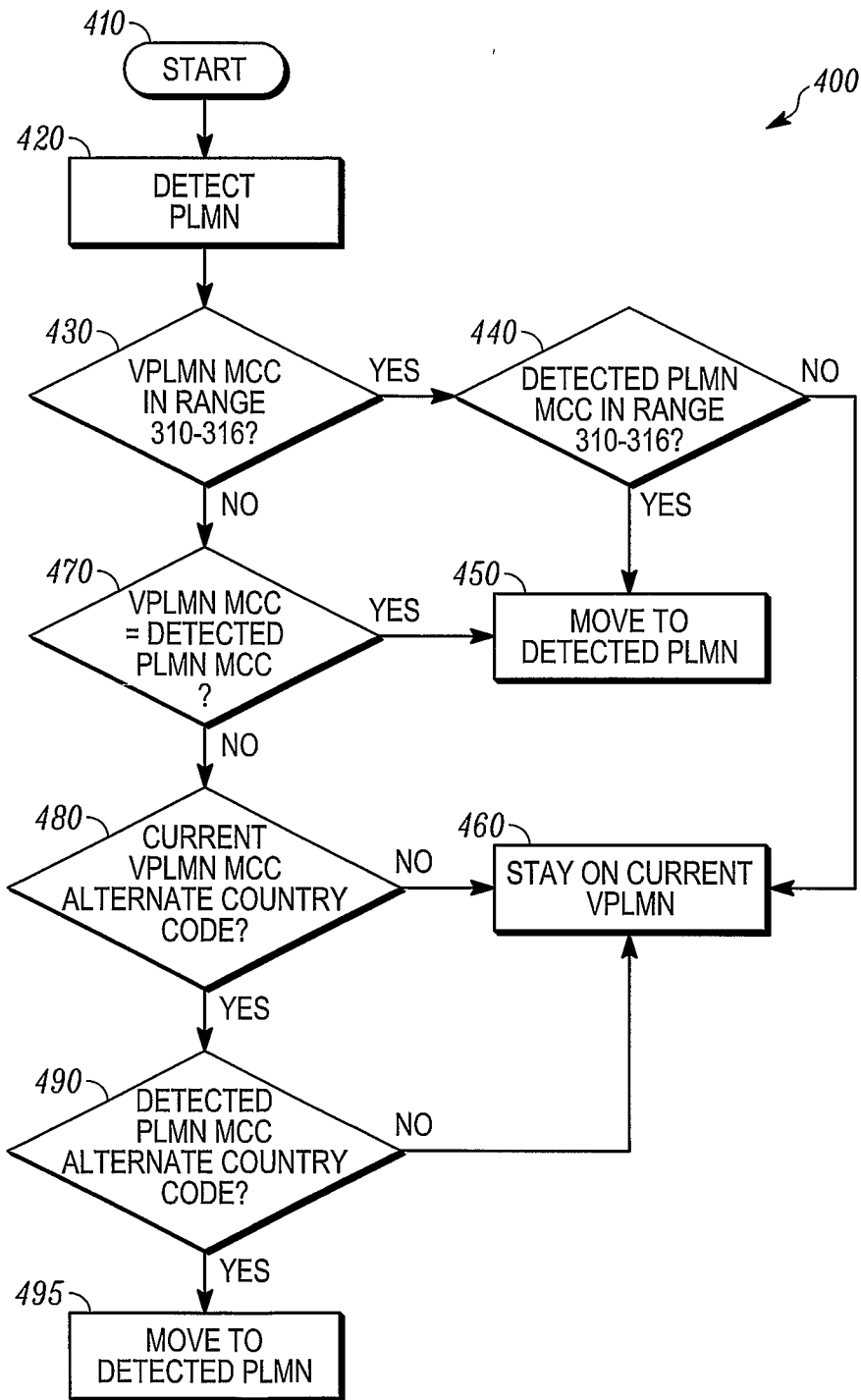
1/4

FIG. 1

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FIG. 2

FIG. 3

4/4
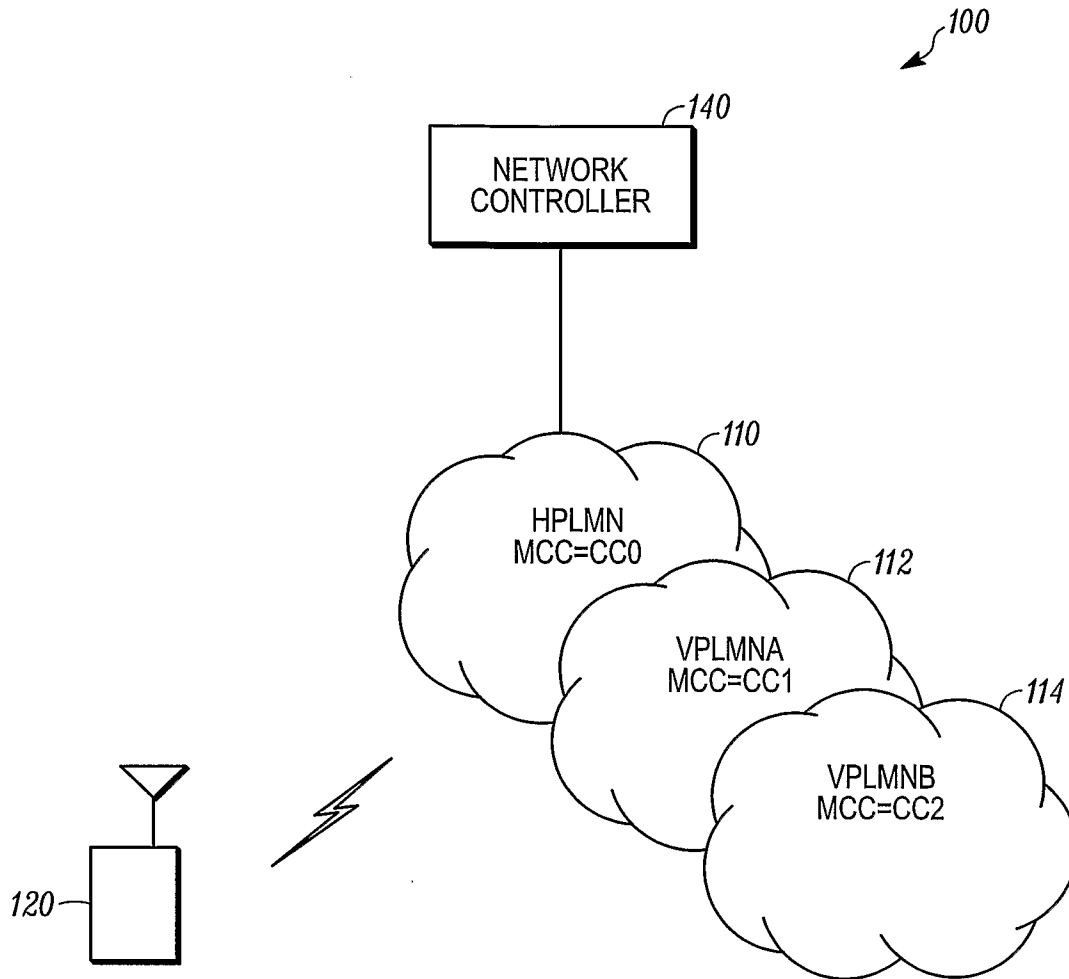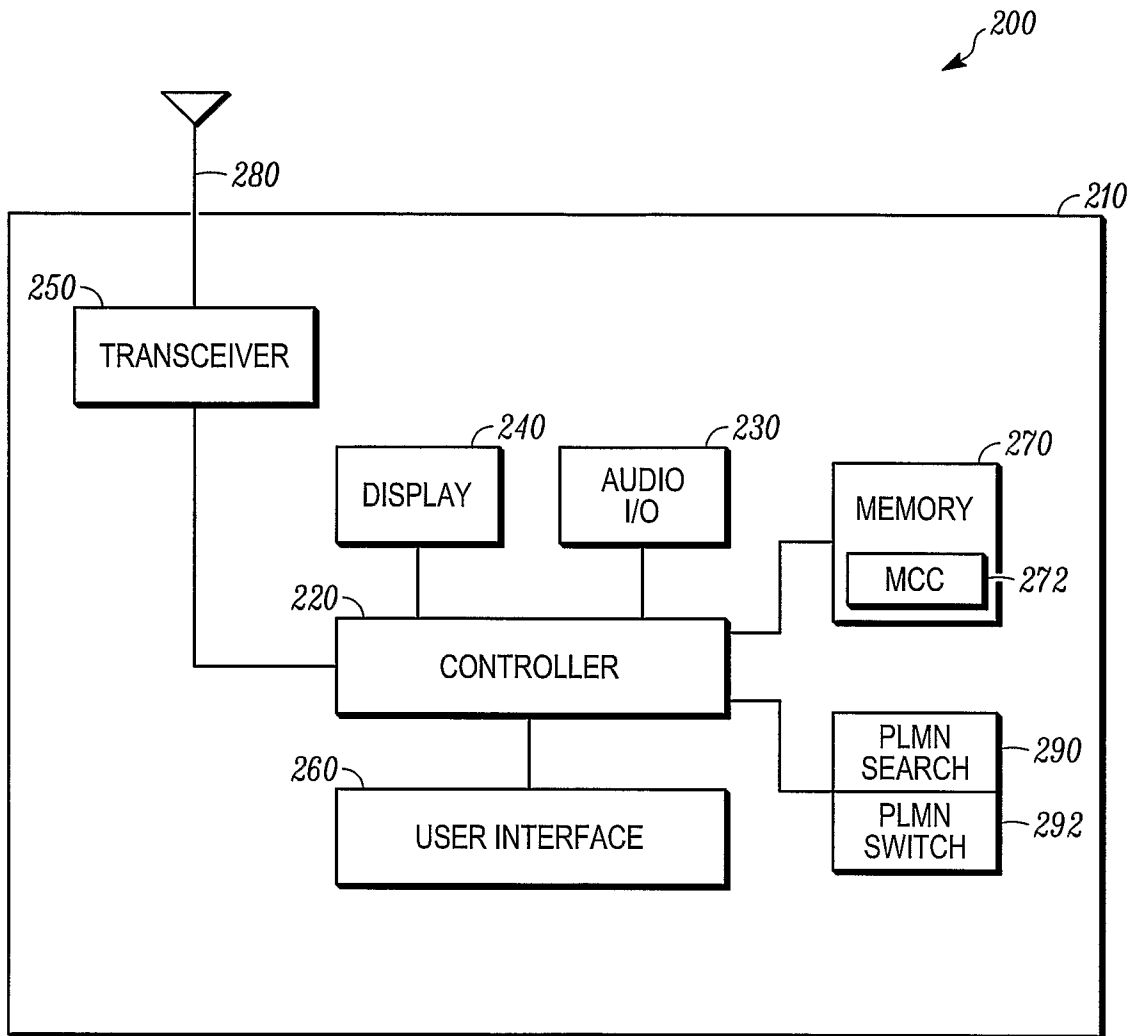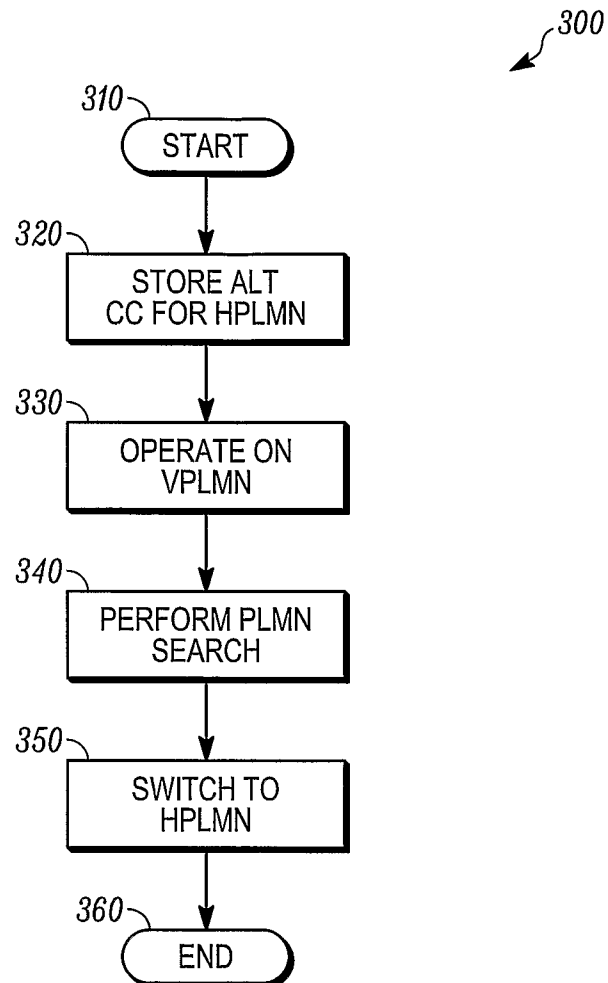
FIG. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2006/024674

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04Q7/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005/107082 A1 (GUNARATNAM JAYASRI ET AL) 19 May 2005 (2005-05-19) paragraphs [0008], [0010], [0018], [0052], [0053], [0057] – [0059] figure 6 ─────	1-19
X	US 2002/119774 A1 (JOHANNESSON REGINA ET AL) 29 August 2002 (2002-08-29) paragraphs [0004], [0006], [0016], [0019], [0020] figures 4,5 ─────	1-19
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| [X] | Further documents are listed in the continuation of Box C. | | [X] | See patent family annex. |

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"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search	Date of mailing of the international search report
26 September 2006	06/10/2006

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

	International application No
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C(Continuation).	DOCUMENTS CONSIDERED TO BE RELEVANT	
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